



## The Amateur in You, Part 2

*What have you been pondering?*



### Effects of feed line reflections

The field and study of transmission line (feed line, in our case) **reflections** is no trivial topic, and I pondered whether I should make this discussion into one more worthy of the *Brass Tacks* column, in which I tend to go a little in-depth with a subject.

But it occurs to me that many who ask questions regarding signal and antenna behavior can benefit from such a discussion, even if they don't have a deep RF (radio frequency) background. So, I'm hoping this explanation will be helpful (understandable, and seen as applicable) to the majority of amateurs.

#### What is a reflection?

When an electrical signal is sent through a wire from some source, such as a stage microphone, AC light switch, or radio transceiver, the signal eventually reaches its load, such as an audio circuit, a light bulb, or an antenna, respectively. The expectation is that all of the power that's sent down the wire will be absorbed (used) by the audio circuit, light bulb, or antenna. However, some aspects of the loads can prevent the signal power from being **completely** absorbed by the audio circuit, light bulb, or antenna.

So now, what happens to the portion of signal power that's not absorbed and put to good use? **It's reflected back to the source.** And the percentage of that power returned to the source is a number we can use to calculate SWR, or *standing wave ratio*:

$$SWR = \frac{1 + \sqrt{P_r / P_f}}{1 - \sqrt{P_r / P_f}}$$

in which  $P_f$  is the signal power **forward** (how much was sent) and  $P_r$  is the signal power **reflected** (the portion that returned).

#### A second chance

However, it turns out that the small portion

of the signal that was reflected back to the source, **will be reflected again by the source, and sent back to the load** (antenna), and we call that **re-reflection**. This re-reflected signal makes its way to the load again, and by the same principles, most of that re-reflected signal is used by the load, while a small portion of that signal is reflected by the load. This entire cycle repeats, until all of the original signal is used by the load.

Say you're using a transceiver to send a 100-watt signal to an antenna system that exhibits an SWR of 1.925:1, meaning it will reflect  $[(1.925 - 1) / (1.925 + 1)]^2 = 10\%$  of it:

1. Your transceiver sends 100 watts
2. Your antenna uses **90 watts** of it, and sends (reflects) 10 watts back
3. Your transceiver resends the 10 watts
4. Your antenna uses **9 watts** of it (totaling  $90 + 9 = 99$  watts), and reflects 1 watt
5. Your transceiver resends the 1 watt
6. Your antenna uses **0.9 watts** of it (totaling  $90 + 9 + 0.9 = 99.9$  watts), and reflects 0.1 watts

Can you see where this is going? It's important to you, because it means that the portion of your signal that was reflected **is not lost power**, but will all be eventually sent out the antenna. The only time any of your signal is actually lost (to heat, for example) is during the trip up and down your coax. This is why [charts for common coax](#) publish loss figures. And this is why amateurs in a bygone era never discussed or even cared about SWR, because *they didn't use coax*.

#### Links for further reading

Those who'd like to (dare to) dig a little deeper into reflections might want to look up the resources that are [posted on my website](#).

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